

11th Annual Peace, Justice & Sustainability Conference

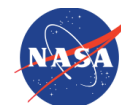
Golden West College

28, April 2017

OCO-2 - Watching the Earth Breathe on a 15 year (and counting) Journey

Karen Yuen

Science Data Applications Lead
Orbiting Carbon Observatory (OCO-2)



Jet Propulsion Laboratory
California Institute of Technology

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The U.S. Fleet of Earth Observing Satellites from NASA



Orbiting Carbon Observatory – 2 (OCO-2)

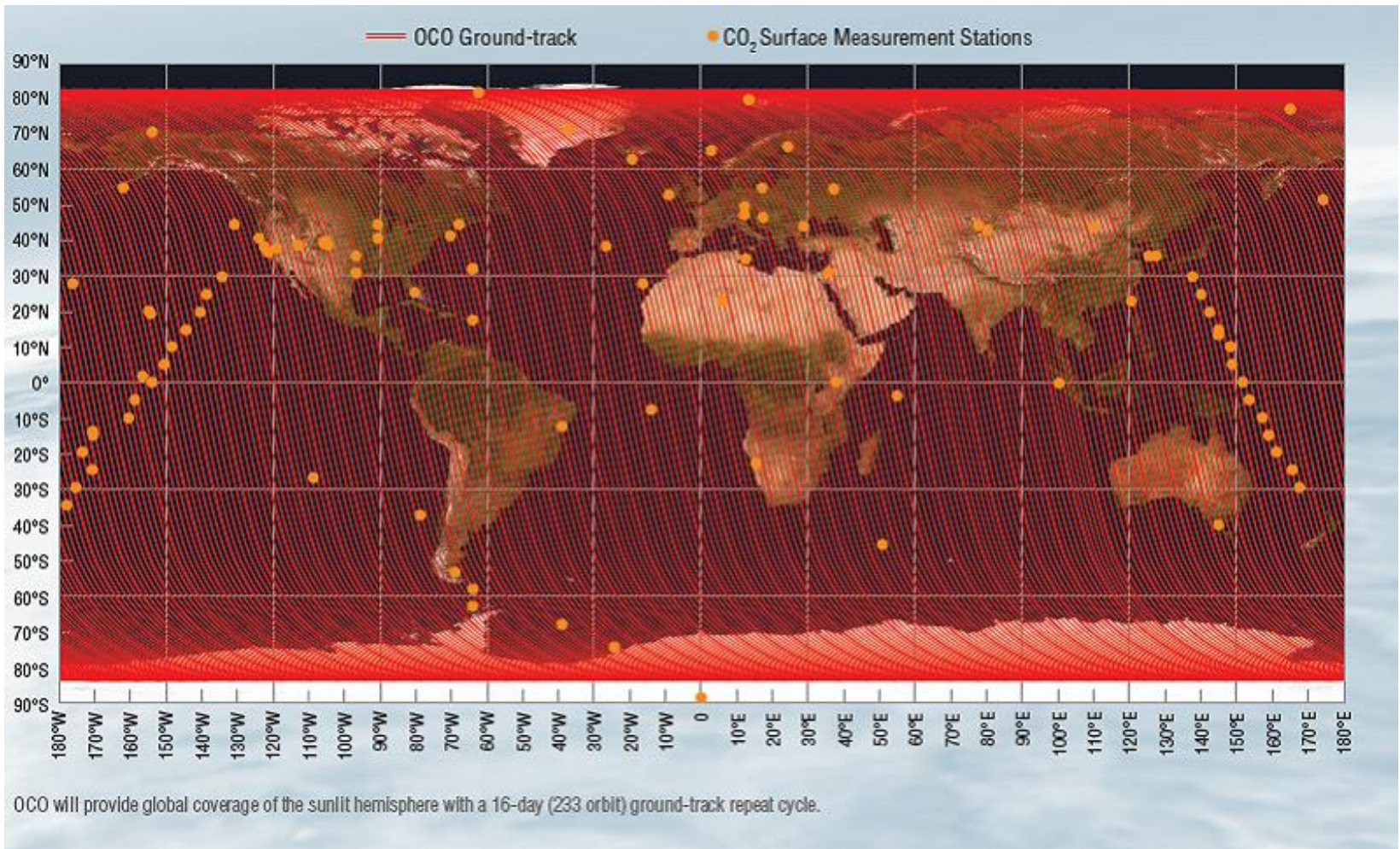


NASA's first dedicated mission to studying Carbon Dioxide from Space.

The Carbon Story



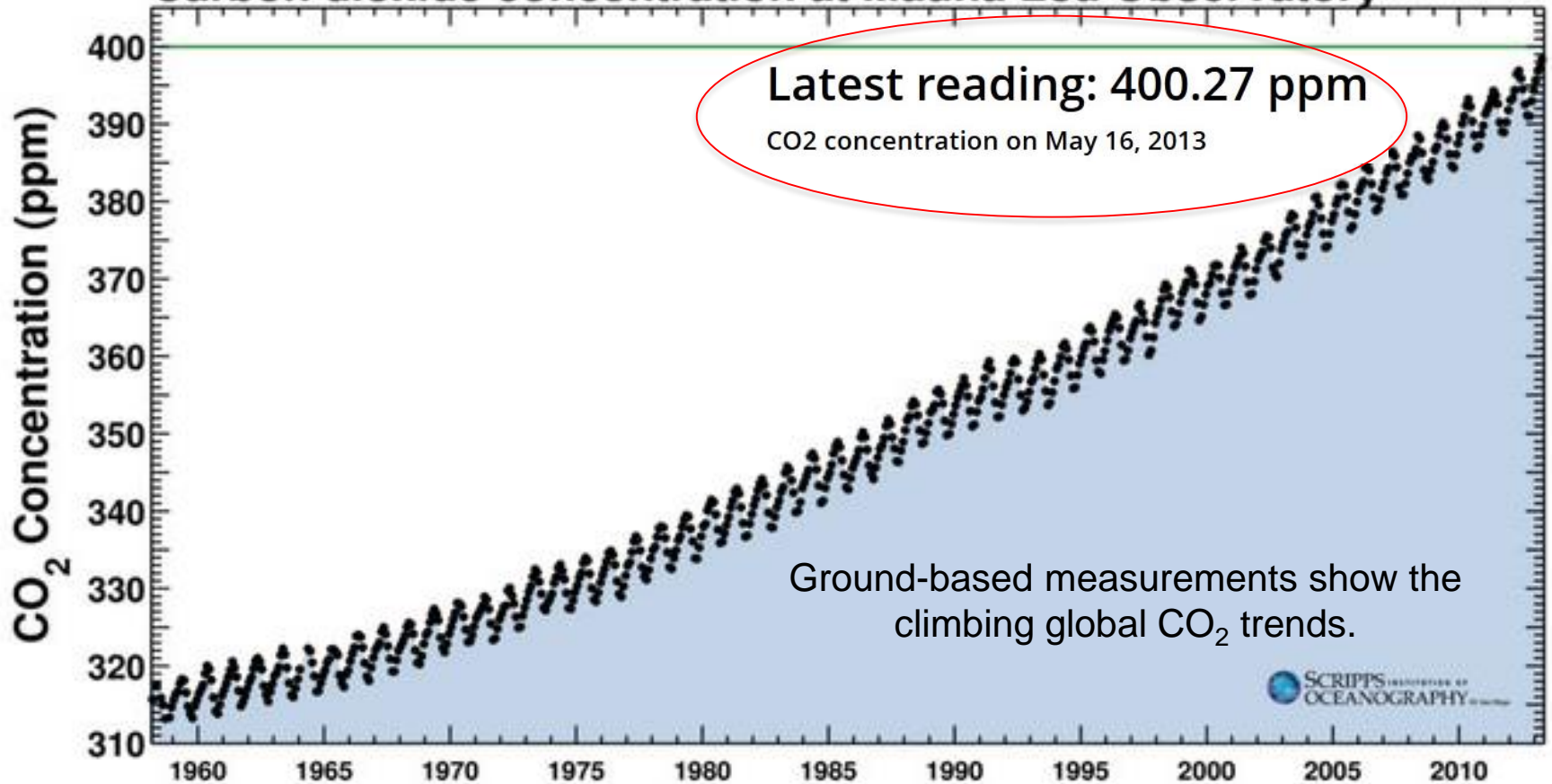
Current Ground System versus OCO-2



...Because we can only manage what we can measure!

Historic Moment in Human History

Carbon dioxide concentration at Mauna Loa Observatory



... and the Trend Continues...

Up-to-date weekly average CO₂ at Mauna Loa

Recent Monthly Average Mauna Loa CO₂

March 2017: 407.18 ppm

March 2016: 404.83 ppm

Last updated: April 5, 2017

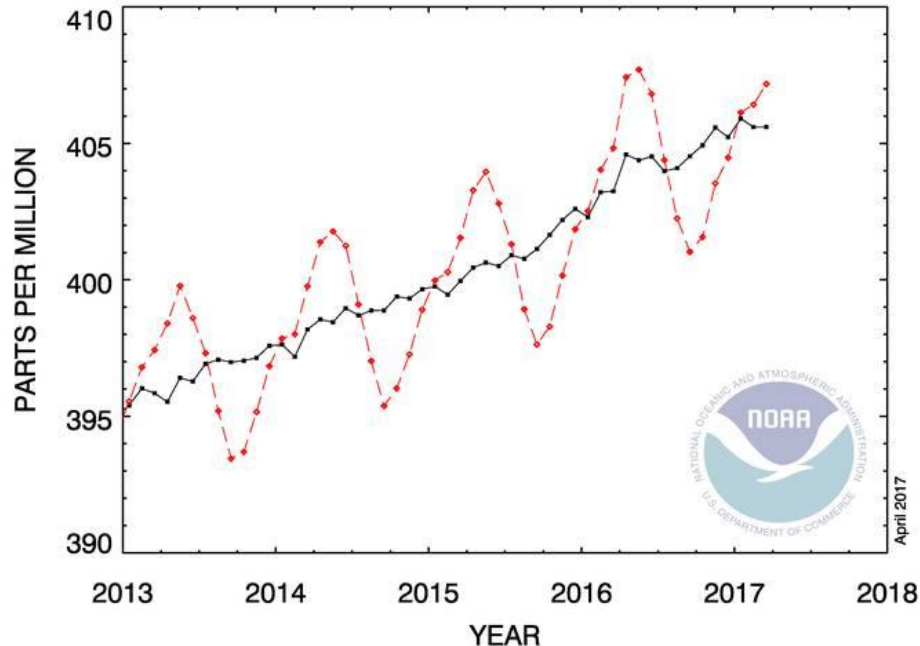
Week beginning on April 16, 2017: 409.61 ppm

Weekly value from 1 year ago: 407.48 ppm

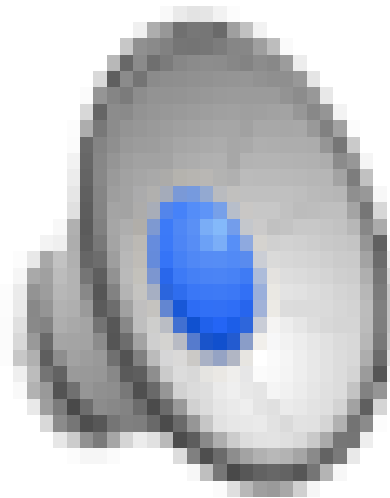
Weekly value from 10 years ago: 387.49 ppm

Last updated: April 24, 2017

RECENT MONTHLY MEAN CO₂ AT MAUNA LOA



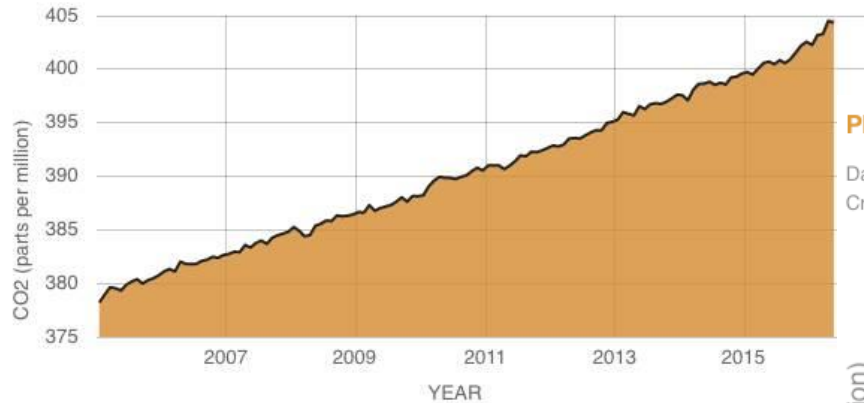
Trend vs. Variation



Carbon Dioxide Trend

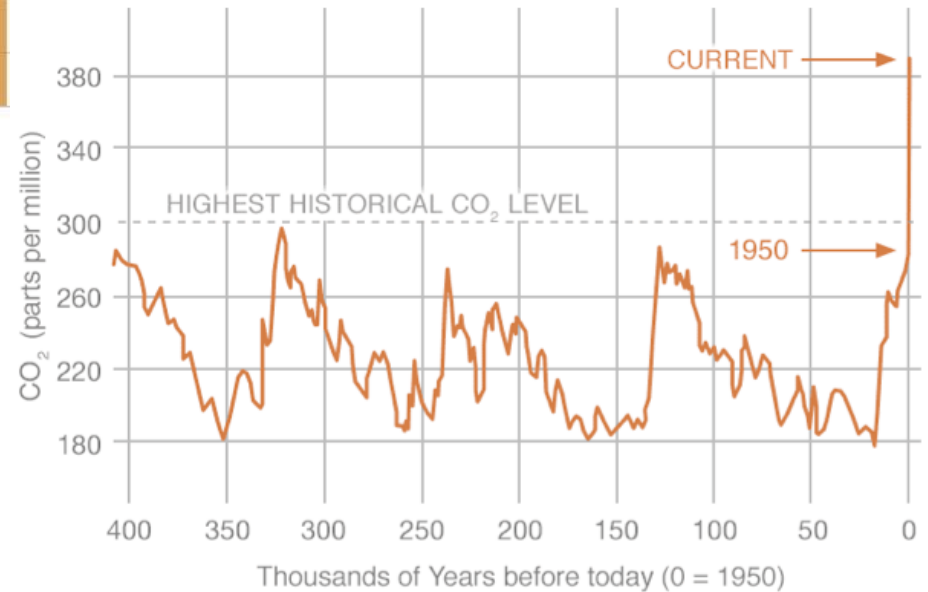
DIRECT MEASUREMENTS: 2005-PRESENT

Data source: Monthly measurements (average seasonal cycle removed). Credit: NOAA



PROXY (INDIRECT) MEASUREMENTS

Data source: Reconstruction from ice cores.
Credit: NOAA



Earth's Vital Sign Trends

SATELLITE DATA: 1993-PRESENT

Data source: Satellite sea level observations.
Credit: NASA Goddard Space Flight Center

RATE OF CHANGE

↑ 3.20
mm per year

July 2015



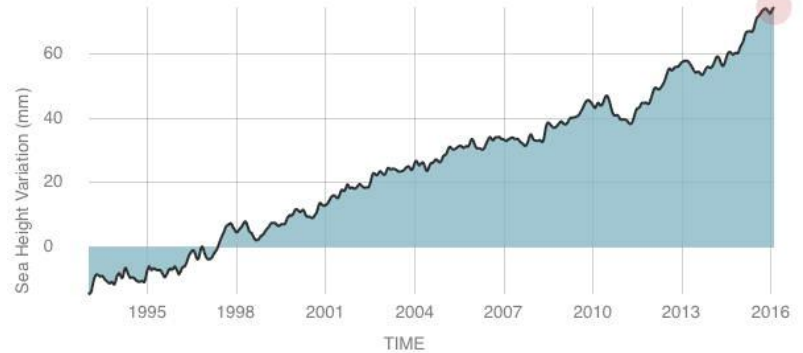
SATELLITE DATA: 1993-PRESENT

Data source: Satellite sea level observations.
Credit: NASA Goddard Space Flight Center

RATE OF CHANGE

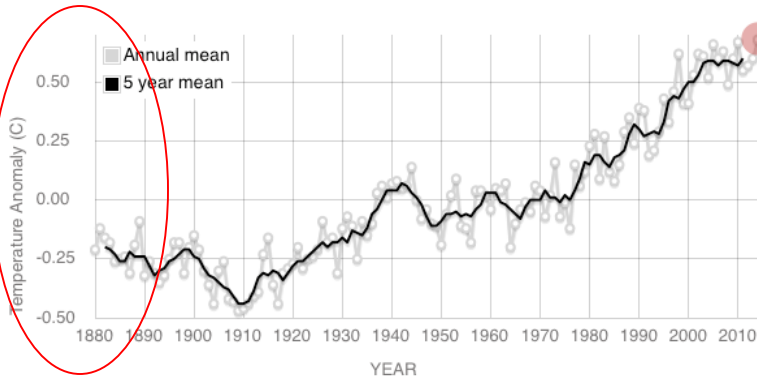
↑ 3.4
millimeters per year
margin: ± 0.4

June 2016



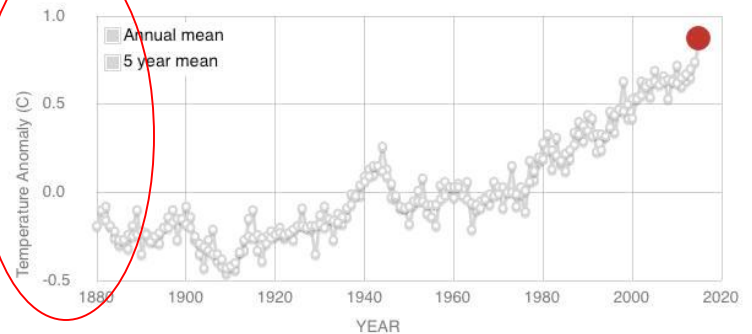
GLOBAL LAND-OCEAN TEMPERATURE INDEX

Data source: NASA's Goddard Institute for Space Studies (GISS).
Credit: NASA/GISS



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Credit: NASA/GISS



Earth's Vital Sign Trends

GREENLAND MASS VARIATION SINCE 2002

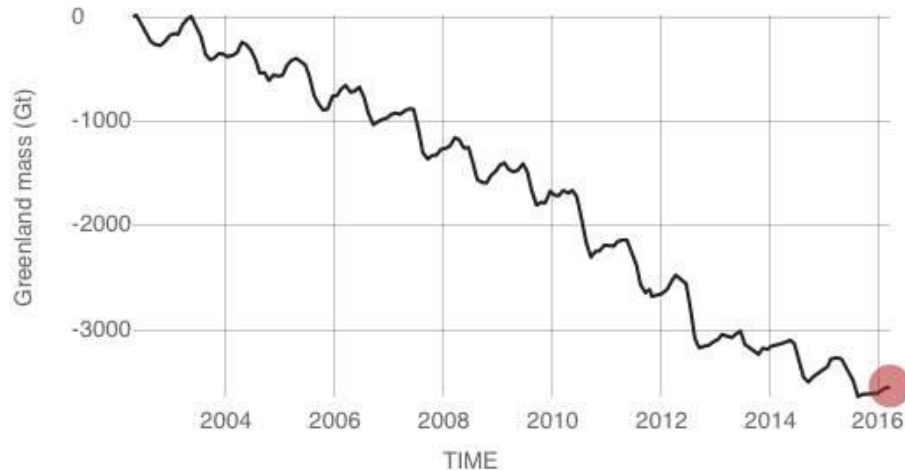
Data source: Ice mass measurement by NASA's GRACE satellites.

Credit: NASA

RATE OF CHANGE

↓ 281.0

Gigatonnes per year
margin: ± 24



ANTARCTICA MASS VARIATION SINCE 2002

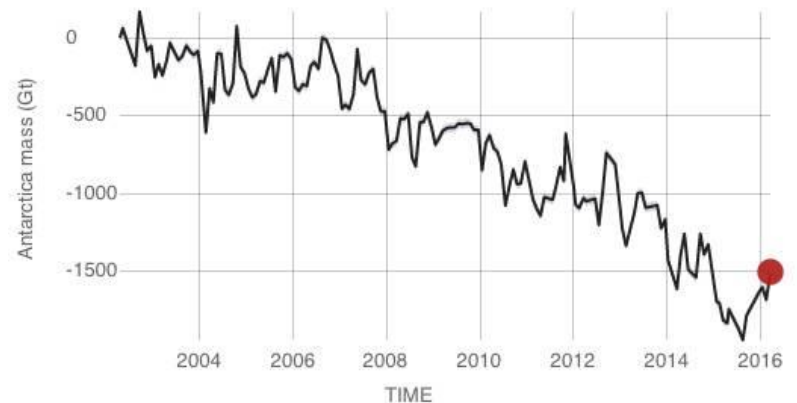
Data source: Ice mass measurement by NASA's GRACE satellites.

Credit: NASA

RATE OF CHANGE

↓ 118.0

Gigatonnes per year
margin: ± 44



The Not So Brief History of Climate Change Study

Education is Key, knowledge is power!

Science versus Public - Misuse to Misunderstanding

Terms that have different meanings for scientists and the public

Scientific term	Public meaning	Better choice
enhance	improve	intensify, increase
aerosol	spray can	tiny atmospheric particle
positive trend	good trend	upward trend
positive feedback	good response, praise	vicious cycle, self-reinforcing cycle
theory	hunch, speculation	scientific understanding
uncertainty	ignorance	range
error	mistake, wrong, incorrect	difference from exact true number
bias	distortion, political motive	offset from an observation
sign	indication, astrological sign	plus or minus sign
values	ethics, monetary value	numbers, quantity
manipulation	illicit tampering	scientific data processing
scheme	devious plot	systematic plan
anomaly	abnormal occurrence	change from long-term average

- Hypothesis
- Theory
- Model
- Skeptic
- Significant

Thank you! Any questions?